

Malaria and the Causation of Intermittent Fever.

(4)

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MALARIA AND THE CAUSATION OF INTERMITTENT FEVER.

Dr. Tommasi-Crudeli and others have claimed that intermittent fever is caused by a bacillus.

Drs. Laveran, Osler, Council *Man* and others have proved, to their own satisfaction at least, that intermittent fever is caused by a microscopic hæmatozoön.

At the meeting of the American Medical Association in Cincinnati, in May, 1888, I presented what I then considered and still consider to be incontrovertible evidence that intermittent fever is caused by exposure to changes of atmospheric temperature,—that, ordinarily, its causation is quantitatively related to, and apparently controlled by the range of atmospheric temperature.¹ It seems to me that both these lines of evidence, which appear to be so divergent, may be true. I feel sure that my own line is. And I have very great confidence in those who have presented the other line of evidence in which they are expert.

Therefore, although those who have held the germ theory of the causation of intermittent fever have not, so far as I know, accepted the evidence which I have collected and published, yet I feel impelled to again ask attention to it. I attempt this the more readily, because the facts and considerations, which it seems to me to make it appear possible that both lines of evidence may

¹ "Malaria and the Causation of Periodic Fever," Journal Amer. Med. Association, Nov. 10, 1888.

be true, were, in the main, held in mind when I read my paper two years ago, but there was not then time to elaborate, and I, therefore, only referred to but did not fully state them.

I suppose that all here are probably familiar with the literature of the subject of the bacillus of malaria, and also that relative to the hæmatozoön of malaria, discovered by Laveran. I may, therefore, devote my time exclusively to that other phase of the subject, on which I have collected evidence, and which is probably little known.

The most important evidence which has been presented by myself is as follows:

1. Statistics of sickness from intermittent fever in Michigan during a long series of years, arranged to show the relation of intermittent fever to changes in atmospheric conditions, and which have proved, to my mind, that the controlling condition is associated with atmospheric temperature, the sickness rising and falling with the temperature. This is shown by Diagram No. 3², which is one of a series prepared to illustrate my previous paper.

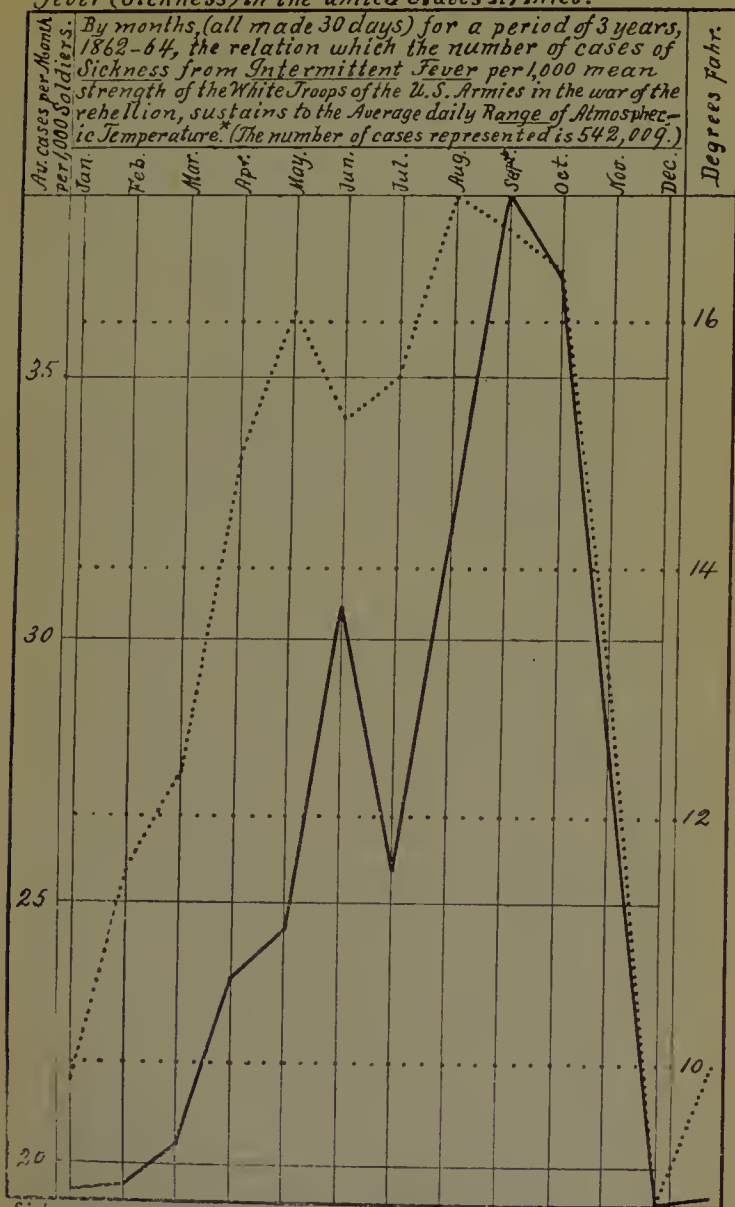
2. Statistics relative to intermittent fever in the United States Armies, elaborated from the medical and surgical history of the war of 1861-5. This evidence is graphically shown in Diagram No. 1.³

An abstract of a summary of conclusions based upon the evidence which I collected, is as follows:

- "2. The *controlling* cause of intermittent fever is exposure to insidious changes, or changes to which one is unaccustomed, in the atmospheric temperature.

- "3. In the mechanism of the causation of intermittent fever, the chief factor is the delay in reaction from exposure to cool air; this delay, extending to a time when greater heat-loss should occur, results in the abnormal accumulation of

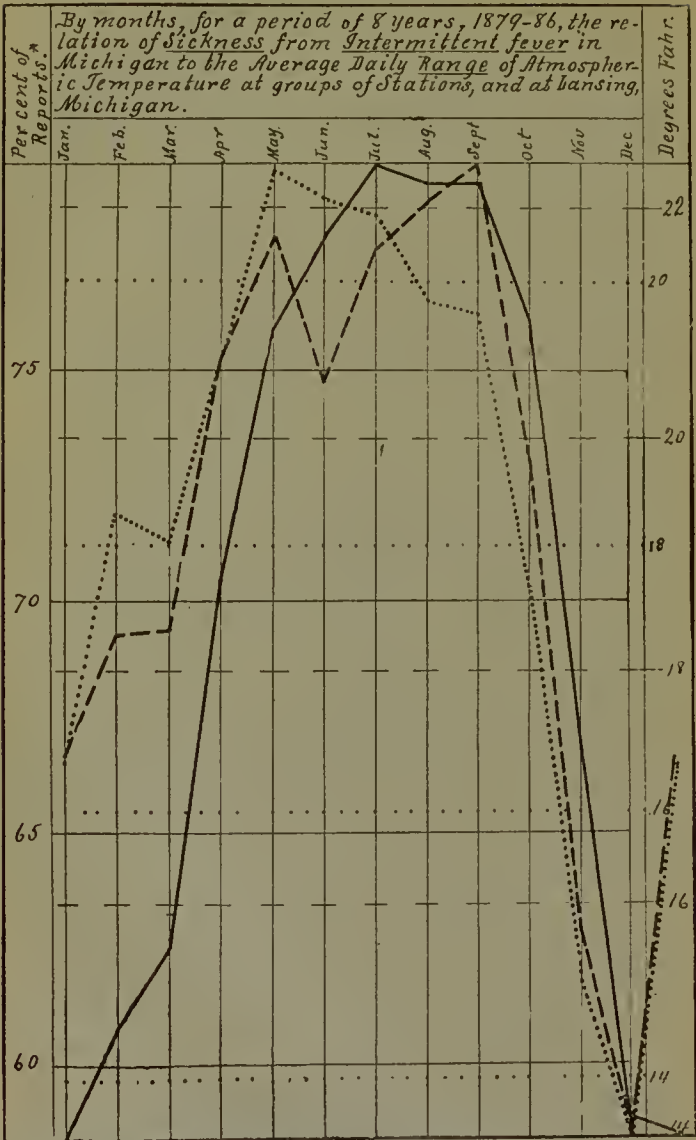
No. 1.—Range of Atmospheric Temperature, and Intermittent fever (Sickness) in the United States Armies.



Sickness ———. Average daily Range of Temperature

* The sickness is compiled from the Medical and Surgical History of the war of the rebellion. The range of Temperature is compiled from a table on page 134 of the Smithsonian Tables Distribution and Variation of the Atmospheric Temp. in the U.S. It is for a period of 8 years, 1862-69, at Naval Observatory, Washington, D.C.

No. 2.— Range of Atmospheric Temperature, and Intermittent Fever (Sickness) in Michigan.

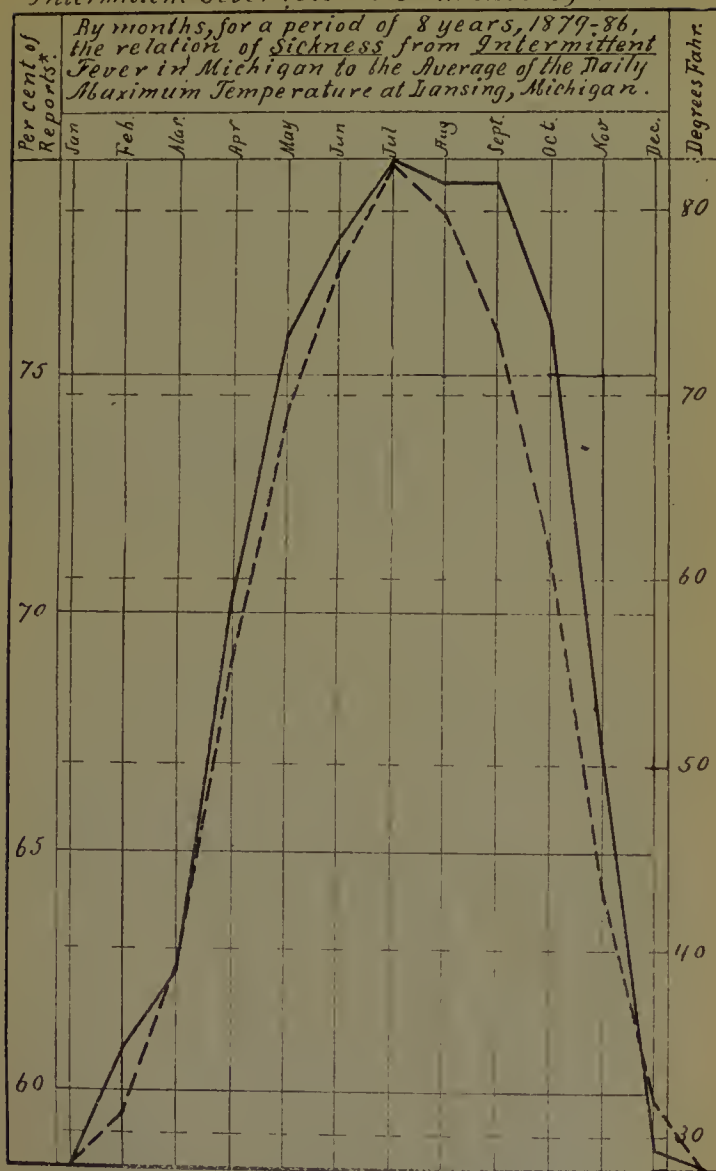


Sickness ——— Average daily Range of Temperature,
Average daily Range of Temperature at Lansing — — — —

*Indicating what per cent of all reports received stated the presence of Intermittent fever then under the observation of the physicians reporting.

Over 35,000 weekly reports of Sickness are represented in this diagram.

No 3.-Maximum Atmospheric Temperature and Intermittent Fever (Sickness) in Michigan.



Sickness—Average maximum Temperature ————
 *Indicating what per cent of all reports received, stated the presence of Intermittent Fever then under the observation of the physicians reporting.

Over 35,000 weekly reports of sickness are represented in this diagram.

TABLES FROM WHICH ACCOMPANYING DIAGRAMS WERE DRAWN.

No. 1.—Sickness from Intermittent Fever in the U. S. Armies, in 1862-4, and Range of Atmospheric Temperature.

| | Jan. | Feb. | Mar. | April | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|--------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| Intermit. fev. (a) | 19.4 | 19.6 | 20.4 | 23.6 | 24.5 | 30.6 | 25.6 | 32.0 | 38.5 | 36.8 | 28.1 | 19.3 |
| Av. range of tem. | 9.87 | 11.55 | 12.36 | 14.88 | 16.10 | 15.21 | 15.57 | 17.01 | 16.76 | 16.41 | 13.12 | 8.87 |

No. 2.—Sickness from Intermittent Fever in Michigan, and Range of Atmospheric Temperature.

| | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Intermittent fever (b) | 58.4 | 60.8 | 62.5 | 70.4 | 75.8 | 77.8 | 79.5 | 79.0 | 79.0 | 76.1 | 67.0 | 58.8 |
| Av. range of temp. (Mich.) | 16.34 | 18.23 | 18.02 | 19.41 | 20.83 | 20.62 | 20.50 | 19.84 | 19.74 | 17.69 | 14.69 | 13.56 |
| Av. range of temp. (Lansing) | 17.25 | 18.29 | 18.33 | 20.67 | 21.72 | 20.46 | 21.61 | 22.05 | 22.35 | 19.81 | 15.73 | 13.99 |

No. 3.—Sickness from Intermittent Fever in Michigan, and Maximum Atmospheric Temperature.

| | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|------------------------|------|------|------|-------|------|------|------|------|-------|------|------|------|
| Intermittent fever (b) | 58.4 | 60.8 | 62.5 | 70.4 | 75.8 | 77.8 | 79.5 | 79.0 | 79.0 | 76.1 | 67.0 | 58.8 |
| Max. temp. at Lansing | 28.2 | 31.1 | 39.1 | 55.7 | 69.2 | 77.0 | 82.3 | 79.9 | 73.5 | 61.3 | 43.3 | 31.9 |

(a) Average cases per month per 1,000 soldiers.

(b) Per cent. of weekly reports which stated the presence of intermittent fever.

heat in the interior of the body, and in disturbed nervous action—the chill; and the final reaction is excessive because of the accumulation of heat, and, sometimes, because it occurs at the warmest part of the day.

“4. The fever is the excessive reaction from the insidious influence of the exposure to cool air; and it is periodical because of the periodicity of nervous action, and, because the *exposure* and the consequent chill are periodical, owing to the nightly absence of the warmth from the sun.

“5. Residence in valleys or low lands through which or upon which cold air flows at night, and thus causes insidious changes in the atmospheric temperature, favors intermittent fever.

“6. *In our climate*, those measures, such as drainage, which enable the soil to retain warmth during the night, and thus reduce the daily range of temperature immediately over such soil, tend to decrease intermittent fever among residents thereon.

“7. In the cure and prophylaxis of intermittent fever, those remedies are useful which lessen torpidity and tend to increase the power of the body to react promptly to insidious changes in atmospheric temperature.”⁴

Preparing, now, to forge a link, in the chain of evidence, which was omitted from my paper, Sir William Moore, who has had great experience and observation in India, says: “So-called malarious fevers are caused by sudden abstraction of heat, or chill, under the influence of cold, and more especially of damp cold. These effects of chill are more marked in hot climates, because of the antecedent exposure to great solar heat, the anæmia and skin debility resulting from heat and the disregard of suitable precautions.”⁵

I think that my statistics indicate that another reason, for there being most intermittent fever in

⁴ Jour. Amer. Med. Assoc., Nov. 10, 1888.

⁵ London Lancet, also Medical Age, Detroit. Feb. 6, 1890, p. 66.

hot climates, is because the difference between the day and the night temperatures is the greatest in hot climates, and, consequently, the demands upon and resulting disturbances of the heat-regulating apparatus of the body are greatest in hot climates.

Intermittent fever is most prevalent in hot climates. In temperate climates, intermittent fever is most prevalent in the warm months. Here a reason similar to that just given applies,—it is then that there is greatest difference between the day and the night temperatures.

I believe that perspiration is probably a factor in the causation of intermittent fever. I do not base this opinion merely upon the facts just stated,—relative to place and time of greatest prevalence; but mainly upon two facts as follows: Perspiration tends to cause chill, because of the fact that evaporation from moist clothing tends to lower the temperature rapidly. I believe that a chill, especially at the warmest time of the day, is, not infrequently, sufficient to start the disease intermittent fever. Excessive perspiration tends to change the condition of the blood; and chill tends to change the condition of the blood, in some such way as follows: When the surface of the body is strongly contracted, the blood is driven from all the surfaces, the circulation is impeded, the blood parts with some of its fluid, and, with it, the salts, which pass into the urine; then there comes a demand of the tissues for blood, thirst is great, which, when satisfied, again fills up the blood-vessels. This rapid changing of the proportion of fluid in the blood tends, I believe, toward the solution or breaking up of the red blood corpuscles. My belief is that the destruction of the red corpuscles is greater than it would be if only the proportion of water in the blood was changed,—that the destruction occurs partly through a disturbance of the proportion of certain salts in the blood. It is not difficult to see how

this may be: Excessive perspiration takes out salts, especially sodium chloride, in considerable quantity; the urine passes out salts in considerable quantity. On the other hand the water drunk to quench the thirst, does not ordinarily take salts into the blood. (Except in cases where common salt is given as a remedy, which is sometimes done by non-professional persons.) According to experiments made many years ago, in the circulating blood, in health, the red corpuscles are preserved by sodium chloride from being dissolved in the albumen.⁶ As this paper is not an exhaustive treatise on this subject, but is intended to be suggestive to other investigators, I do not now attempt to collate recent evidence on the changes in the blood. In order, however, to account for the destruction of the red corpuscles, the formation of the pigment, and for the phenomena of intermittent fever, I see no need for the micro-organism which is alleged to be parasitic in the blood, in intermittent fever. It seems to me that all of the phenomena can be accounted for about as well without the parasites as with; but it seems to be a general fact in nature that whenever a highly-organized being commences to break down, there are generally organisms that await the occurrence, and when the breaking down process is of elements microscopic in size, I believe that microörganisms are generally there. I accept the evidence of the eminent men, who have reported that they are present in the blood in intermittent fever.

But if we grant that malarial fever *is* caused by microörganisms, parasitic in the blood, it has remained to be explained how it is that the micro-organisms only cause intermittent fever under certain conditions of the atmosphere. That intermittent fever does occur under some conditions, and does not occur under other conditions, has

⁶ Dalton's Human Physiology, First Edition, page 56. Human Physiology, Flint, Fourth Edition, 1888, page 432.

long been positively known. I claim that the statistics which I have collected prove what those conditions are; and that the relation of those conditions to intermittent fever is quantitative and causal. I refer more especially to the evidence (exhibited in Diagram No. 1) ~~relative~~ to the half million and more cases of intermittent fever which occurred in the United States Armies, during the war, in 1862-4; and to the evidence of the recorded experience of physicians in Michigan, during eight years, which is exhibited, in graphic form, in Diagrams Nos. 2 and 3. ~~+~~

* Page 5 of this pamphlet

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